UNIVERSITY OF MARYLAND

Department of Physics

Quiz #9
Linear Momentum Conservation
Problem 1

In an inertial reference frame (IRF) a proton initially at rest experiences a glancing collision with another proton that has a velocity V_0 in x-direction. After the collision the proton initially moving goes off at an angle of θ and the mass initially at rest goes off at an angle φ. Assume that both particles have the same mass. Assume that the final magnitudes of the velocities are the same for the entire problem.

a.) Show that if the magnitudes of the final velocities of the protons are the same that it is necessary that the angles be equal and opposite relative to the positive x-axis. (Hint: use the equation with conserves momentum in the y-direction to prove this.)
b.) Find the relationship between the initial velocity and the final velocities of the protons in the x-direction. (Hint: use the equation that conserves momentum in the x-direction to find this relationship.)
c.) If the initial velocity of the proton that is moving before the collision is 4x10^6m/s what is the velocity of each proton in the x-direction.
d.) Now using conservation of energy check to find a relationship between the initial and final velocities and compare this to your answer for part b).
e.) Now find the deflection angles by using the equation that conserves momentum in the x-direction. Write the equation out and then substitute the relationship you found between the initial velocity of the moving particles and the final velocity of the particles and compare this to the answer you got in part a).

Problem 2

Two particles with mass m and 4m are moving toward each other along the x-axis with the same initial velocities. The particle with mass m is traveling to the left, while the particle with mass 4m is traveling to the right. They undergo an elastic collision such that particle m moves downward after the collision. a) Find the final speeds of the two particles. b) What is the angle at which particle 4m is deflected?

Problem 3

A 2g bullet is shot into a 200g block of wood, confined to a horizontal plane, and becomes embedded in the block of wood. The block is initially at rest. The block of wood slides a distance of 20m before coming to rest. Assume that the coefficient of kinetic friction is one half.

a) What kind of collision problem is this?
b) What is the initial speed of the bullet?